

Application No. 10/061,435

Amndt. dated: December 22, 2004

Reply to Office Action mailed: September 28, 2004

Amendments to the Specification:

Please replace the paragraph beginning at page 5, line 15, with the following rewritten paragraph:

On Page 1, change the paragraph following the heading "RELATED APPLICATIONS" to read as follows:

- - This is a continuation-in-part of U.S. Patent Application Serial No. 09/209,635 filed on December 10, 1998 entitled "ERROR SELF-CHECKING AND RECOVERY USING LOCK-STEP PROCESSOR PAIR ARCHITECTURE," (Patent No. 6,393,582 issued May 21, 2002), the disclosure of which is incorporated herein by reference as if explicitly set forth. - -

On page 10, change the paragraph beginning at line 12 to read as follows:

- -In principle, the detection of divergence need only be detected at opne point, that is, where the data leaves the ~~local~~ logical processor 10 at the PCI to SAN I/O bridge 24. That is, the processor could be designed with full redundancy, including two copies of main memory, and the results could be compared at only one point – where the data leaves the processor 10 and is placed on the SAN. However, to reduce the cost of the design and to reduce the latency

error detection, a single copy of main memory is provided. For this configuration, it is desirable to check any data that the master processor 12 writes to the memory 20 before it is written, because once written, we have lost the "second opinion" – there will be no other immediate opportunity to detect the error. - -

On page 24, change the paragraph beginning at line 1 to read as follows:

- - 15.8 Any process or interrupt process that ~~were~~ was suspended due to SAN Services FRIP being invoked ~~are~~ is allowed to run and normal operation resumes. - -

On page 26, change the paragraph beginning at line 11 to read as follows:

- -There are two types of inquiry messages. The first is not unlike a ping, and is used initially to determine if a resource is available. The second type of inquiry message is used as a query when a message packet has not been acknowledged. Instead of retrying the message or

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packet, an inquiry message that includes data and a special transaction ID is sent. No retries of the original message or packet are attempted until the inquiry message is returned. If an inquiry message is lost (i.e. times out with no response), the system (i.e. the cluster) will first elevate the "error" to a higher level of severity and may in fact mark the target as down and remove it as a resource to the system. This is not desirable in the invention, where an attempt is being made to recover in a controlled manner that will enable the processor to continue to function as if the error had not occurred.- -

On page 27, change the paragraph beginning on line 13 to read as follows:

- -The implementation of the double inquiry message solution may depend on the type of inquiry message used. For example, the SAN protocol provides for three types of inquiry messages – client inquiry messages, pre-inquiry messages, and error recovery inquiry messages. Client inquiry messages are used for discovery purposes. For example, "sniffers" used by the system to check for viable paths. As it less critical if a client inquiry message is lost, the current implementation does not alter the one inquiry message implementation for client inquiry messages, although a two client inquiry message system ~~[[is]]~~ may be implemented. Pre-inquiry messages are used ~~[[to]]~~ when verifying a particular path before it is used. For pre-inquiry messages, two inquiry messages are used, each with a 20 ms timeout. Error recovery inquiry messages are used for verification before client data is resent, and are discussed above with reference to Fig. 3. For error recovery inquiry messages, two inquiry messages are used, each with a 20 ms timeout (i.e. 20 ms packet timeout and 20 ms inquiry message timeout).- -

On page 27, change the paragraph beginning on line 25 to read as follows:

- - The inquiry message method executed by the network resource 25 is shown in Fig. 4. Firstly, a data message is sent 100 to the logical processor 10. The logical processor 10 is currently executing a recovery procedure as described above. If a response is not received 102 from the logical processor 10 before the expiry of the first timeout period X (see Fig. 3), a first inquiry message is sent 104. As the logical processor 10 is still conducting the error recovery procedure (see Fig. 3), the inquiry message is lost. If the network resource 25 does not receive 106 a response by the second timeout period Y (see Fig. 3), a second inquiry message is sent ~~106~~108. As discussed above, the sum of the two timeout periods X and Y is selected to be longer than

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the expected recovery period Z for the logical processor 10. Accordingly, if the failure of the logical processor to respond to the data message is as a result of conducting the error recovery procedure discussed above, the second inquiry message will be received 110 and the original data message will be resent. I however, no response is received after a third timeout period, the failure of the logical processor 10 is deemed to be for another reason, and the error is reported to a SAN administrator function for handling. For example, the SAN administrator function may remove the logical processor as a network resource, or elevate the error status of the resource to a higher level.- -